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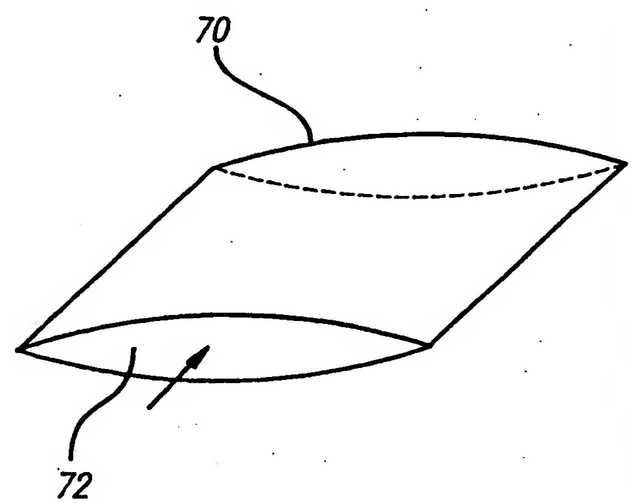
(54) Title: METHODS AND APPARATUS FOR LAMINATING SHEET MATERIAL

(57) Abstract

A laminating assembly (60) includes laminating material (62) on which an inner layer of adhesive (64) is applied, with an outer layer of adhesive (66) applied to the inner layer of adhesive. The melting point of the outer layer of adhesive is lower than the melting point of the inner layer of adhesive. The adhesive of the inner layer of adhesive may be active at room temperatures such as a pressure-sensitive adhesive. The outer layer of adhesive may have a surface density which is relatively low when compared to that of the inner layer of adhesive so that less heat is needed to soften or activate the outer layer of adhesive. Therefore, common office printing machines such as photocopiers and laser printers may be used to laminate sheet material with the laminating assembly, which also allows a user to print on the laminating assembly while the lamination of the sheet material is taking place. The laminating assembly may also be configured with top and bottom sheets with different shrink rates to eliminate thermoforming.



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METHODS AND APPARATUS FOR LAMINATING SHEET MATERIAL

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part application of U.S. Patent Application Serial No. 08/551,068 filed October 31, 1995.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to methods and apparatus for laminating sheet material in common office machines such as laser printers or photocopiers.

Description of the Related Art

Generally speaking, most lamination processes involve enveloping an object to be laminated with a transparent plastic material and applying heat to meld the plastic material or adhesive coated on the plastic material together around the edges of the object and to the object itself. Various techniques have been developed with the goal to simplify this process and to make it more widely applicable.

One example of prior laminating technology is U.S. Patent No. 4,243,458 which issued January 6, 1981, to J. D. Giulie and which describes a method for making a prefabricated laminating packet with a tab. The laminating packet according to Giulie has a pair of laminating sheets which are held together in a proper relationship by a pull-off tab attached by means which are not heat responsive such as special tape. The pull tab enables an operator to utilize such laminating packets with laminating machines having heated platens and rollers and either with or without a dedicated carrier. After the laminating sheets have been heated, the tab is removed and discarded. Drawbacks of such a laminating packet include the need to utilize a dedicated laminating machine as well as the specialized pull-tab structure for use with laminating machines, both drawbacks unnecessarily increasing the cost of utilizing such laminating technology.

One of the commercially available produces on the market for laminating sheet material is a laminating pouch produced by Ibico®, Inc. of Elk Grove, Illinois. This laminating pouch utilizes a carrier and a laminator. The item to be laminated is centered inside the laminating pouch which is then set inside the carrier. The carrier is then feed into the laminator to laminate

the item. One of the disadvantages of such a system is that the carrier and the laminator are required pieces of equipment. That is, the laminating pouch will not work well with high-speed photocopiers and laser printers so common in office today.

Office printer machines such as laser printers and photocopiers have heated components, one of which is known as a *fuser*. The fuser is heated to a temperature which fuses or solidifies the ink which has just been applied to the paper. One of the problems in utilizing office machines for laminating is that the laminating assembly is propelled through the machine at a speed which does not allow adhesives to reach their melting points; that is, the laminating assembly does not contact the fuser long enough to melt the adhesive. In addition to the speed, the fact that the heat must travel through a layer of polyester to melt the adhesive, and then travel through the material to be laminated to melt the adhesive again, also prevents adhesives from reaching their melting points. These layers and the speed at which the laminating pouch is pulled through the laser printer result in an effective temperature that the adhesive is subject to approximately 200°F to 250°F depending on the thickness of the mylar laminating pouch and the thickness of the material being laminated. Further, conventional laminating assemblies usually use an adhesive with a melting temperature above 300°F, whereas the adhesive used in the laminating pouches is approximately 200°F.

Accordingly, one of the primary objects of the present invention is to provide laminating technology which is easily implemented and utilized in common office machines.

It is another object of the present invention to provide methods and apparatus for laminating sheet material which do not require the use of a dedicated laminating machine.

It is further object of the present invention to provide methods and apparatus for laminating sheet material which allow a user to print while laminating sheet material.

It is yet another object of the invention to provide methods and apparatus for laminating sheet material in common office machines which substantially reduces or eliminates thermoforming.

SUMMARY OF THE INVENTION

These and other objects are achieved by the laminating technology, including an assembly and a method for laminating sheet material, of the present invention. According to one aspect of the invention, an assembly for laminating sheet material includes laminating material on which plural layers of adhesive are applied: an inner layer of adhesive applied to the

laminating material and an outer layer of adhesive applied to the inner layer of adhesive. The melting point of the outer layer of adhesive is lower than the melting point of the inner layer of adhesive. Accordingly, office printing machines which have relatively low operating temperatures (when compared to dedicated laminating machines) may be used to laminate sheet material with the laminating assembly because the outer layer of adhesive will be activated at these lower operating temperatures.

According to another aspect of the present invention, the adhesive of the inner layer of adhesive is preferably an adhesive which is active at room temperatures. Accordingly, the outer layer of adhesive only needs to soften in order for the inner layer of adhesive to adhere to the sheet material to be laminated. The softening of the outer layer of adhesive may be accomplished at relatively low temperatures, for example, at temperatures below about 300°F but preferably on the order of about 180°F. Examples of room temperature-active adhesives suitable for the inner layer of adhesive include acrylic pressure-sensitive adhesives.

To further facilitate the low-temperature activation of the laminating assembly, the outer layer of adhesive preferably has a surface density which is relatively low when compared to that of the inner layer of adhesive. Accordingly, a relatively low surface density requires less heat to become softened or activated. This also implies that less adhesive is required, thereby lowering the cost of the laminating assembly. An example of a relatively low surface density of the outer layer of adhesive is on the order of less than about 5 grams per square meter. By contrast, it may be preferable to apply the inner layer of adhesive with a surface density of at least about 3 grams per square meter.

According to another aspect of the invention, the laminating assembly may be configured to facilitate the feeding of the laminating assembly into an office printing machine. This may be accomplished by applied room temperature-active adhesive strips to the outer layer of adhesive to adhere to the sheet material. Alternatively, the laminating material may be heat sealed along a fold line to define a sealed leading edge. The sealed leading edge may then be fed into an office printing machine first, thereby providing an integral surface for the printing machine to use to propel the laminating assembly.

One of the advantages of the present invention is that the laminating assembly may be printed upon by the office printing machine while the lamination of the sheet material is taking place. In this regard, if a laser printer is to be used for lamination, a user may download a file to be printed from a printer with the laminating assembly (with the sheet material positioned

therein) loaded in either the manual feed tray or the automatic feed tray of the printer. Accordingly, the file will be printer on the outer surface of the laminating material of the laminating assembly analogous to a normal printing operation with paper.

According to another aspect of the present invention, a method allows a user to laminate stock in a printing machine such as a photocopier or a laser printer. The method includes the steps of providing a laminating assembly analogous to that described above. The stock to be laminated is then positioned within the laminating assembly, thereby contacting the outer layer of adhesive. The laminating assembly with the stock may then be fed into the printing machine. Accordingly, stock may be laminated without the use or expensive of a dedicated laminating machine. The method is as widely applicable as the wide availability of office printing machines.

Another aspect of the present invention is that a laminating assembly minimizes or substantially eliminates thermoforming during the lamination process. The laminating assembly has a top sheet and a bottom sheet. The bottom sheet is defined as the sheet of the laminating assembly which passes adjacent to a fuser in a laser printer or other office printing machine; as such, the bottom sheet is subject to higher temperatures than the top sheet. Typically, higher temperatures cause greater shrinkage in materials, which, in the case of conventional laminating assemblies, caused thermoforming. To offset the tendency to thermoform, the bottom sheet has a relatively small shrink rate with respect to the top sheet. For example, the ratio of the shrink rates of the top and bottom sheets is about 3:1. Accordingly, the bottom sheet shrinks less than the top sheet, and the laminating assembly does not thermoform.

Other aspects, features, and advantages of the laminating technology of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the present invention.

Brief Description of the Drawings

FIG. 1 is a top view of an exemplary embodiment of a laminating assembly illustrating the principles of laminating technology of the present invention;

FIG. 2 is a side view of a laminating assembly shown with sheet material to be laminated mounted or sandwiched therein;

FIG. 3 is a perspective view of a laminating assembly with the sandwiched sheet material being fed into a laser printer;

FIG. 4 is a top view of a laminating assembly with sheet material laminated therein, particularly showing printing on the laminating assembly;

FIG. 5 is a cross-sectional view of another exemplary embodiment of a laminating assembly illustrating the principles of laminating technology of the present invention;

FIG. 6 is a perspective view of another exemplary embodiment of a laminating assembly of the present invention;

FIG. 7 is an enlarged cross-sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is an enlarged cross-sectional view similar to that of FIG. 7, showing stock laminated within the laminating assembly;

FIG. 9 is a schematic view of a laser printer with a conventional laminating assembly illustrating thermoforming;

FIG. 10 is a perspective view of a laminating sleeve in accordance with the present invention;

FIG. 11 is a side view of the laminating sleeve of FIG. 10, showing a laminating assembly positioned therein;

FIG. 12 is a schematic view of a laser printer and a laminating sleeve in accordance with the present invention, as well as a computer in communication with the laser printer;

FIG. 13 is an enlarged cross-sectional view of a laminating assembly with stock positioned within a laminating sleeve of the invention;

FIG. 14 is a perspective view of another preferred embodiment of a laminating assembly of the present invention;

FIG. 15 is a plan view of a laminating assembly of the invention, illustrating the provision of adhesive strips;

FIG. 16 is a view similar to that of FIG. 15, illustrating an alternative configuration of adhesive strips;

FIG. 17 is a perspective view of yet another preferred embodiment of a laminating assembly of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, exemplary heat-activated laminating assemblies are shown and illustrate the principles of the laminating technology of the present invention. Exemplary embodiments of this technology may take many different forms; however, the disclosure herein will detail only specific exemplary embodiments of the present invention and will not provide an exhaustive description of all other embodiments within the scope of the laminating technology set forth herein and in the appended claims.

Particularly referencing FIG. 1 of the drawings, a laminating assembly 10 in accordance with the present invention is shown. The laminating assembly 10 generally includes laminating material 12 coated on one side or face thereof with heat-activated adhesive 14. The sheet of laminating material 12 may be divided into two substantially equal portions 16 and 18 along a central fold line 20 transversely defined substantially across the middle of the laminating material 12.

The laminating material 12 may be made from any suitable laminating material. Laminating material is generally plastic-like and is nonreactive or inert up to relatively high temperatures in order for a laminating machine to activate the adhesive with heat while not damaging the laminating material itself. An example of such laminating material is polyethylene terephthalate, commonly known as mylar.

Referring to FIG. 2, the laminating assembly 10 is shown with the laminating material 12 folded substantially in half along the fold line 20. Stock to be laminated, e.g., sheet material 22 such as paper, is positioned between the portions 16 and 18 of the laminating material 12 with the heat-activated adhesive 14 directed toward the sheet material 22. The laminating material 12 is preferably at least twice as large in dimensional as the sheet material 22 to be laminated, whereby each portion 16 and 18 is at least the same size as and preferably a little larger than the sheet material 22 so that opposing edges of the halves 16 and 18 meet and align with each other. Further, the sheet material 22 should be centered within the folded laminating material 12 between the portions 16 and 18. Although this embodiment of the laminating assembly 10 may laminate sheet material 22 in many instances, the laminating assembly 10 is prone to thermoforming and may require the user to assist the lamination process by holding the laminating assembly 10 straight as it exits the laser printer. At room temperatures, the heat-activated adhesive 14 is not active so that the adhesive 14 is not substantially tacky; therefore, the sheet material 22 may be moved freely around on the laminating material 12 against the

adhesive 14 for desired positioning.

With additional reference to FIG. 3, the laminating material 12 with the centrally positioned, enveloped sheet material 22 is fed into a laser printer 24 as shown by arrow 26. The laminate-material/sheet-material combination is preferably fed into the printer 24 by means of a single-load tray 28, which is common to laser printers or other office machines, but may also be fed by means of a dedicated paper tray as well. It is also preferable for the fold line 20 to define the leading edge of the laminating assembly 10 during the printing operation to minimize the possibility of the laminating material 12 folding back and catching on different internal parts of the laser printer 24. With the fold line 20 defining the leading edge of the laminating assembly 10, the laminating assembly 10 is then fed through the laser printer 24 along the longitudinal axis of the laminating material 12, with the fold line 20 defining a transverse axis.

Laser printers such as the one shown in FIG. 3 typically employ rollers to advance printing stock therethrough. The temperature of these rollers and other heated elements within the printer 24 is typically in the range of about 375 degrees Fahrenheit to 450 degrees Fahrenheit. However, the effective temperature of the rollers relative to sheet material fed through them is estimated to be in the range of 175 degrees Fahrenheit to 250 or 300 degrees Fahrenheit. Therefore, the adhesive 14 used to coat the laminating material 12 is preferably heat activatable around the latter temperature range, i.e., approximately 150 degrees to 275 degrees and, more generally, below the effective temperature of the office printing machine to be used. Further, the laminating material 12 is then preferably nonreactive or inert to heat within the temperature range at which the laser printer operates.

As the laminate-material/sheet-material combination or sandwich structure passes through the laser printer 24, the heat from the rollers, printing heads, heating elements, and/or other internal heated structures activate the adhesive 14, causing the adhesive 14 to adhere to the sheet material 22 and to the corresponding opposing overlapping edge portions of the laminating material 12. The sheet material 22 is therefore laminated within the laminating material 12 and protected from moisture, dust, and so on.

In order to apply the laminating technology of the present invention conveniently to laser printers and other office printing machines with heating elements, the overall thickness of the laminate-material/sheet-material structure must be on the order which a laser printer can handle without jamming or malfunctioning. This operating thickness range for most laser printers is approximately 2 mils to 15 mils. Therefore, the thickness of the laminate-

material/sheet-material structure should also be in this approximate operating thickness range. Generally speaking, paper for use with laser printers and photocopiers has a thickness approximately in the range of 2 mils to 5 mils. The heat-activated adhesive 14 is preferably coated onto the laminating material 12 with a thickness in the range of approximately ½ mil to 1 mil. The thickness of the laminating material 12 is preferably in the range of approximately 1½ mils to 3 mils. Accordingly, the overall thickness of the laminating assembly 10 with the sheet material 22 sandwiched therein may be in the range of approximately 6 mils to 12 mils, depending upon the specific application, but will most often be in the range of approximately 10 mils to 12 mils.

Although the laminating technology disclosed herein is shown in relation to a laser printer, any other machines with heating elements may be used with the laminating assembly 10, including other office machines, such as photocopiers, facsimile machines, and multifunction machines with facsimile and photocopy capability, or dedicated laminating machines, if desired. However, because of the proliferation of laser printers in offices and homes today, laser printers offer a convenient and widely applicable heat source for the laminating assembly.

With further reference to FIG. 1, room-temperature-active adhesive 30 is preferably applied to the laminating material 12 on the same face as the heat-activated adhesive 14. The room-temperature-active adhesive 30 is active, i.e., tacky, at room temperatures and is preferably pressure sensitive. More specifically, the room-temperature-active adhesive 30 is applied to at least one of the portions 16 or 18 of the laminating material 12 defined by the fold line 20. As shown in the exemplary embodiment of FIG. 1, the room-temperature-active adhesive 30 is applied to the laminating material 12 on portion 18 along the fold line 20, extending transversely from one longitudinal edge to the other. Although any suitable application may be employed, it is preferable for the room-temperature-active adhesive 30 to be applied or layered directly onto the heat-activated adhesive 14 in the form of a strip. Alternatively, the room-temperature-active adhesive 30 may be applied directly to the laminating material 12 without the heat-activated adhesive 14 extending over the strip 30, depending upon the particular laminating application or production technique.

Further referencing FIG. 2, with the application of the room-temperature-active adhesive 30, when the sheet material 22 to be laminated is placed, positioned, or mounted on one of the portions 16 or 18, the room-temperature-active, pressure-sensitive adhesive 30 aids in holding

the sheet material 22 in place while the other portion 16 or 18 is folded over to sandwich the sheet material 22 within the laminating material 12. The room-temperature-active adhesive 30 further aids in holding the sheet material 22 in place while the laminate-material/sheet-material combination is being handled prior to and during the lamination process. It has been found that a single strip of adhesive 30 applied along the fold line 20 is effective in holding one of the edges of the sheet material 22 in alignment with the fold line 20, as well as generally aligning the sheet material 22 with the other edges of the laminating material 12. The low-tack adhesive strips 30 also facilitate the feeding of the lamination assembly 10 into the laser printer. Typically, laser printers have wheels which pick up or engage sheet material to be printed upon from one side of the sheet. Thus, by applying low-tack adhesive strips 30 to the leading edge of the laminating assembly 10, the tendency of the rollers to feed just the laminating material 12 in contact with the roller is eliminated. Also according to the laminating technology disclosed herein is the application of additional room-temperature adhesive to other areas of the laminating material 12, if desired, to further secure the sheet material 22 or to secure other areas of the sheet material 22 within the laminating material 12.

Reference is now made to FIG. 4 in which is shown the sheet material 22 laminated within the laminating material 12. As mentioned above, it is preferable for the top edge of the sheet of material 24 to abut the fold line 20, particularly if the room-temperature-active adhesive 30 is applied along the fold line 20. As the laminating assembly according to the laminating technology described thus far may employ common office machines such as laser printers, photocopiers, and multifunction facsimile/photocopy machines to provide the necessary heat to activate the heat-activated adhesive, then it is further preferable to be able to print indicia or other text onto the laminating material 12. The printing of alphanumeric text may take place while the lamination process initially takes place, as shown in FIG. 3, or after the sheet material 22 is already laminated within the laminate sheet 12. As shown in the exemplary embodiment of FIG. 4, the sheet material 22 laminated by the laminating material 12 may be a letter serving as an exhibit in, for example, a legal proceeding. Therefore, a user may desire to print corresponding indicia on the laminating material 12 by means of a computer word-processing program and the laser printer 24 or by means of a photocopier.

An additional exemplary embodiment of a laminating assembly 40 according to the principles of the present invention is shown in FIG. 5. Instead of a single sheet of foldable laminating material, the laminating assembly 40 according to this embodiment includes two

separate laminating material sheets 42 and 44 coated with heat-activated adhesive 46 on one side or face thereof. The laminating material sheets 42 and 44 may be coated with the heat-activated adhesive 46 individually or may be formed by cutting the laminating material 12 shown in the exemplary embodiment of FIG. 1 along the fold line 20, such that the portions 16 and 18 substantially form the laminating material sheets 42 and 44.

According to this embodiment, a sheet of material 48 to be laminated is positioned or placed between the laminating material sheets 42 and 44 with the layered or sandwiched combination of sheets being fed into, for example, a laser printer as shown and described in relation to FIG. 3. As previously described, it is preferable for the laminating material sheets 42 and 44 to be slightly larger than the sheet of material 48 to be laminated so that the sheet of material 48 is completely protected on all sides from the elements.

In addition to the coating of heat-activated adhesive 46, room-temperature-active adhesive 50 may be applied to at least one but preferably both of the laminating material sheets 42 and 44. Although the room-temperature-active adhesive 50 may be applied in any desired pattern or position on the laminating material sheets 42 and 44, it is preferable for the adhesive 50 to be applied along edges of the laminating material sheets 42 and 44 to stably secure the sheet of material 48 between the laminating material sheets 42 and 44 prior to applying heat for lamination. Furthermore, it is desirable to apply the room-temperature-active, pressure-sensitive adhesive strips 50 in the form of strips at least along the edges of the laminating material sheets 42 and 44 which define the leading and trailing edges of the laminate assembly 40 while being fed into a heat-providing machine such as a laser printer.

According to alternative embodiments of the laminating technology of the present invention, only one laminating material sheet 42 (or 44) may be used to laminate only one side of the sheet material 48 with the other side of the sheet material 48 remaining not laminated or exposed. Alternatively, multiple sheets of the laminating material sheets 42 and 44 may be used to create a desired laminating effect or layered sheet-material/laminating-material structure; or the upper layer and/or the lower layer of laminating material may be formed of two or more adjacent or slightly overlapping sheets.

With general reference to the drawings, an exemplary method of the laminating technology of the present invention generally includes the steps of coating the heat-activated adhesive 14 or 46 onto one face of the laminating material 12 or 42 and 44; placing, positioning, mounting, or enveloping the sheet material 12 or 48 onto or within the laminating material

against the heat-activated adhesive to form a layered or sandwich structure; and feeding the laminate-and-sheet-material sandwich structure into a heat-providing machine such as a laser printer. The method may further include the steps of applying room-temperature-active, pressure-sensitive adhesive 30 or 50 to the face of the laminating material coated with the heat-activated adhesive; and printing text onto the face of the laminating material which does not have the heat-activated adhesive coated thereon.

Alternatively, the sheet material 12 or 48 may be placed, positioned, or mounted against or on only one sheet of the laminating material 42 or 44 so as to laminate only one side of the sheet material. In addition, the sheet material 12 or 48 may be mounted or enveloped by more than two sheets of laminating material 12 or 42 and 44, depending upon the particular effect desired by an individual user, with the plural sheets of laminating material forming a layered structure.

Regarding the two types of adhesive according to the laminating technology disclosed herein, the heat-activated adhesive 14 and 46 is preferably an amorphous polyhexane adhesive which is substantially clear at least upon activation and also resistant to ultraviolet light so as not to discolor or deteriorate over time. However, other suitable heat-activated adhesives may be used as well, including hot-melt adhesives or thermoplastic cements such as polyamide resins. Further, depending upon the temperature of the heat-supplying machine like a laser printer, modifiers such as plasticizers, polymers, resinous materials, and waxes may be added to the heat-activated adhesive so that the heat-activated adhesive will be active at lower or higher temperatures or at a specific temperature below the temperature at which a particular office machine operates. Furthermore, the heat-activated adhesive 14 and 46 is inactive at room temperatures which may be as high as approximately 130 degrees Fahrenheit or higher, particularly in areas which are typically not air conditioned such as storage areas and transportation containers. In addition, ultraviolet (UV) stabilzers may be added to the adhesive to stabilize the adhesive and to protect any images that may be printed on the document to be laminated against UV radiation.

One example of a commercially available adhesive is Adcote® 33G1AM heat seal coating produced by Morton International, Inc., of Chicago, Illinois. Adcote 33G1AM is a solvent-based gel lacquer and may be used as a heat seal coating on polyester film, oriented polypropylene films, primed aluminum foil, and paper. Adcote 33G1AM is formulated to seal to oriented polystyrene, HIPS, rigid polyvinylchloride, high-density polyethylene, or

polypropylene. Coatings made from Adcote 33G1AM are clear, have good blocking resistance, and good hot tack properties. Typical properties of Adcote 33G1AM generally include: solids of about 28.5%, viscosity of 450 cps at 125°F, density of about 7.1 lbs./gal. at 125°F, solvents of Toluene/VM&P Naphtha, and a minimum heat-activation range of about 200°F to 250°F. Another example of a suitable adhesive is Adcote® 37T77 water-based heat seal coating also produced by Morton International, Inc., which is resistant to higher levels of moisture than is Adcote 33G1AM. Typical properties of Adcote 37T77 generally include: solids of about 35%, viscosity of less than 350 cps at 77°F, density of about 8.2 lbs./gal., and a minimum heat-activation range of about 180°F to 250°F.

The room-temperature-active adhesive 30 and 50 may be a propylene-hexene copolymer with a melting point of about 250 degrees Fahrenheit and a peel force of about two-and-a-half pounds to five pounds for a one-inch strip pulled off stainless steel. This type of room-temperature-active, pressure-sensitive adhesive is described in U.S. Patent No. 5,262,216 issued on November 16, 1993, to G. H. Popat et al., which is incorporated herein by reference.

Further referencing the laminating material 12 and the laminating material sheets 42 and 44, the size of the laminating material should be at least slightly larger than the sheet material 22 and 48 to be laminated. As the most common size of paper in the United States is 8½ inches by 11 inches, the laminating material 12 should be at least 8½ inches by 22 inches and preferably 8¾ inches by 22¼ inches so that there is at least an eighth of an inch overlap around the edges of the sheet material 22. More generally, the laminating material should be at least one-and-a-half percent larger than the sheet material 22 and 48 to be laminated. In addition, the laminating material 12 and the laminating material sheets 42 and 44 may be suitable adapted for use with other sizes of sheet material which are readily used in heat-providing office machines such as laser printers, for example, A4 (8.27 inches by 11.69 inches), legal (8½ inches by 14 inches), and so on. Finally, it is preferable for the laminating material 12, 42, and 44 to be clear or translucent so that the sheet material 22 and 48 is viewable therethrough, and to be an ultraviolet-light retardant to provide further protection for the heat-activated adhesive 14 and 46 applied thereon.

With reference to FIG. 6, another exemplary embodiment of a laminating assembly 60 in accordance with the present invention is shown. The laminating assembly 60 includes a sheet of laminating material 62 coated on one side thereof with plural layers of adhesive, for example, an inner layer of adhesive 64 and an outer layer of adhesive 66. The laminating material 62

may be made from material analogous to that described above (e.g., polyester) and divided into first and second portions by a fold line. The laminating assembly 60 shown in this figure is configured so that the inner layer of adhesive 64 has a melting point which is relatively high when compared to that of the outer layer of adhesive 66. The inner layer of adhesive 64 is preferably a pressure-sensitive adhesive with an aggressive level of tack, and the outer layer of adhesive 66 is preferably a hot-melt adhesive. An example of a pressure-sensitive adhesive which may be used for the inner layer of adhesive 64 may be a water-based adhesive which is substantially thermostable even at relatively high temperatures, for example, in excess of 300°F.

With additional reference to FIG. 7, the outer layer of adhesive 66 is preferably a hot-melt adhesive such as polyester or ethylene vinyl acetate with a melting point in the range of 180°F to 350°F. The outer layer of adhesive 66 is also preferably nontacky or inactive at room temperatures (i.e., less than about 120°F). The hot-melt adhesive 66 is preferably applied to the laminating material 62 in a relatively thin layer, for example, about 2 grams per square meter (g/m^2) to 5 g/m^2, so that the hot-melt adhesive 66 has a melting point in the upper range, for example, 210°F to 350°F. Accordingly, activation of the hot-melt adhesive 66 is substantially reduced during shipping and handling. In addition, there are more commercially available adhesives with high melting points than with low melting points. Another advantage of applying the hot-melt adhesive 66 in a relatively thin layer is that there is less volume-per-unit area of adhesive to heat up to the melting point; accordingly, the thin-layered hot-melt adhesive 66 activates more quickly and more effectively than if applied at conventional thicknesses. However, it may be preferable to configure the outer layer of adhesive 66 with a hot-melt adhesive is a relatively low melting point, such as 180°F to 210°F, because many of the advanced printers in use today use special paper, inks, and other materials to achieve high-quality results. These special materials (which may include silicone finishing oils, clay-coated surfaces, ultraviolet light coatings, scuff-resistance coatings, alkaline pigments, etc.) may be damaged at the high operating temperatures of dedicated laminators.

The inner layer of adhesive 64 is preferably a pressure-sensitive adhesive with a high degree of tack or activity at room temperatures. The inner layer 64 is applied to the laminating material 62 in a relatively thick layer, for example, at least about 10 g/m^2 and preferably about 15 g/m^2 of surface density. Such a relatively greater surface density compared to that of the outer layer of adhesive 66, the inner layer of pressure-sensitive adhesive 64 may accomplish a substantial portion of adhering stock 68 to laminated to the laminating material 62.

Accordingly, the hot-melt adhesive layer 66 does not need to melt completely in order for the pressure-sensitive adhesive layer 64 to begin adhering to the stock 68, but only needs to become soft enough for imperfections in the surface of the stock 68 (for example, paper fibers) to penetrate through the hot-melt layer 66 into the pressure-sensitive layer 64. This situation is possible because hot melt adhesives typically do not transition from a solid state to a liquid state at a specific temperature but rather transition from a solid non-tack state to a liquid tackified state over a particular range. Therefore, the heat from an office printing machine needs only to be sufficient to diffuse through the laminating material 62 to soften the hot-melt layer 66 to laminate the stock 68. Further, as the hot-melt layer 66 is relatively thin, less heat per unit of area and per unit of time is required to activate the hot-melt adhesive.

Another advantage of a relatively thin hot-melt layer 66 is the reduction or substantial elimination of the oozing of adhesive caused by the heat and pressure of an office printing machine. Such adhesive may collect on components of the office printing machine and cause paper jams. Conventional one-layer laminating pouches require a surface density of about 20 g/m^2 of hot-melt adhesive. With the two-layer configuration of the present invention, a surface density of only about 1 g/m^2 to 2 g/m^2 of hot-melt adhesive is preferred, resulting in an adhesive reduction of about 10 to 20 times over conventional arrangements. In addition, as the inner layer 64 is preferably a pressure-sensitive adhesive (for example, an acrylic-based adhesive), the inner layer 64 will not melt under the heat and pressure of the office machine and will not ooze out of the laminating assembly 60.

Another advantage of the provision of the pressure-sensitive adhesive at the inner layer 64 is that the laminating assembly 60 is resistance to heat which may activate the hot-melt adhesive after the stock 68 has been laminated, thereby lessening the integrity of the lamination. If the stock 68 has been laminated in the laminating assembly 60 and subjected to heat sufficient to soften or activate the hot-melt adhesive, then the stock 68 may become dislodged. However, according to the present invention, the pressure-sensitive adhesive at the inner layer 64 continues to adhere to the stock 68 and ensuring the integrity of the lamination at high temperatures.

The pressure-sensitive layer 64 also ensures a strong and even lamination by absorbing water in the stock 68 which may be vaporized while being laminated. The stock 68 will have some degree of water which will be vaporized when subject to the heat of, for example, a laser printer. Accordingly, it is preferable for the inner layer 64 to be a water-based acrylic pressure-

sensitive adhesive which will absorb water vapor from the stock 68. In conventional one-layer hot-melt adhesive laminating pouches, the hot-melt adhesive does not absorb the water so that uneven lamination occurs because of water trapped between the adhesive and the stock.

One of the problems encountered when laminating stock in a laser printer is that the laminating exiting the printer with the stock ends up in a curled or curved configuration when cooled. This results from what is known as *thermoforming*. With additional reference to FIG. 9, when a conventional laminating pouch 100 exits a laser printer 24' as shown by the arrow, gravity pulls the leading edge of the pouch 100 downward toward the printer 24'. The pouch 100 when exiting is hot and relatively soft but cools quickly in the ambient air. This cooling solidifies the pouch 100 in the downwardly curved shape. Therefore, the final product, that is, the stock within the laminating pouch 100, is wrinkled and curved and generally unsatisfactory.

In addition, laser printers include a component called a *fuser*, which is indicated by reference numeral 102. The fuser 102 is heated to a high temperature and "fuses" the ink to the paper as the paper travels pass by. When the laminating pouch 100 passes by the fuser 102, the side of the pouch 100 adjacent to the fuser 102 is subject to more heat than the other or opposite side of the pouch. This heat differential is further accentuated by the sheet material within the pouch 100 which absorbs a portion of the heat from the fuser 102 and, in a sense, "insulates" the other or opposite side of the pouch 100 from the fuser 102 to a certain degree. Accordingly, the side of the pouch 100 adjacent to the fuser 102 will shrink to a greater degree than will the opposite side of the pouch 100. The difference in shrinkage between the two sides of the pouch 100 also causes thermoforming.

Thermoforming is substantially reduced when using the laminating assembly 60 of the present invention because the inner layer 64 of pressure-sensitive adhesive provides a substantial portion of the adhesion to the stock 68. Thermoforming may be reduced by at least 20% by using the laminating assembly 60 to laminate the stock 68.

With additional reference to FIGS. 10–13, thermoforming may be further reduced by the implementation of a laminating sleeve 70 which aids the laminating assembly 60 to exit the laser printer 24' in a linear fashion. The laminating sleeve 70 has an inner slot 72 in which the laminating assembly 60 (with the stock 68) is inserted as shown by the arrow in FIG. 10. The laminating sleeve 70 with the laminating assembly 60 with the stock 68 positioned in the inner slot 72 (as shown in FIG. 13) is then fed through the laser printer 24' and exits therefrom in a substantially linear manner, which is shown in FIG. 12. (Note: The laminating sleeve 70, the

laminating assembly 60, and the stock 68 are only indicated by reference numeral 70 in FIG. 12 for clarity.)

With particular reference to FIG. 13, the laminating sleeve 70 is preferably made from supercalendered paper with the inner slot 72 coated with a release coating 74. The term *supercalendered* indicates paper which has been pressed between rollers to compress the fibers, thereby yielding paper which is thin and strong. Typically, laser printers are able to feed and print upon stock consistently which is no more than about 12 mils thick, so it is preferable to use supercalendered paper for the laminating sleeve 70 to minimize the overall thickness of the laminating assembly/sleeve combination. (The thickness of the laminating material 62 is preferably about 2 mils.) The release coating 74 provides a high-energy surface which allows sufficient surface attraction between the laminating material 62 of the laminating assembly 60 and the supercalendered paper of the laminating sleeve 70. This surface attraction holds the laminating assembly 60 to the laminating sleeve 70 while passing through the laser printer 24'. The surface attraction is enhanced by the electrostatic printing process common in laser printers, which processes charges the sheets to cause static attraction. After exiting from the laser printer 24', the laminating assembly 60 may be removed from the laminating sleeve 70.

In addition to thermoforming, another problem encountered with conventional laminating pouches is that many office machines such as laser printers do not consistently feed the laminating pouches into the machine. Many times a paper jam occurs because the top portion of the laminating pouch is drawn into the laser printer while the bottom portion and the stock to be laminated remain in the feeder tray.

This drawback is eliminated in accordance with the present invention. With additional reference to FIG. 14, the laminating assembly 60 may be sealed (for example, by heat sealing) along a leading edge 76 thereof, for example, along about a thirtieth (1/30) of an inch to a quarter (¼) of an inch of the laminating assembly, as shown by the dotted line. Accordingly, when the laminating assembly 60 is fed into a laser printer, the top portion and the bottom portion of the laminating assembly 60 are both drawn into the laser printer at the same time, along with the stock 68 therebetween.

Alternatively, with reference to FIGS. 15 and 16, strips of adhesive, preferably low-tack adhesive, may be applied to the outer layer of adhesive 66 (not indicated) for holding the laminating assembly 60 together while being fed into a laser printer. More specifically, as shown in FIG. 15, an adhesive strip 78 may be applied across fold line 80 of the laminating

assembly 60. When the stock 68 is placed in the laminating assembly 60 and the laminating assembly is folded along the fold line 80, the adhesive strip 78 adheres to the stock and defines an integral leading edge for feeding into a printing machine. With reference to FIG. 16, the laminating assembly 60 may be configured as shown with adhesive strips 82 leading from the fold line 80 to ends of the laminating assembly 60. The adhesive strips 78 and 82 are preferably formed of low-tack pressure-sensitive adhesive so that a user is able to reposition the stock 68 to be laminated, if desired, prior to lamination.

With further reference to FIG. 12, a computer 90 is shown in communication with the laser printer 24'. In order to feed the laminating assembly 60 (or the laminating assembly/sleeve combination 60, 70) into the laser printer 24', a user may place the laminating assembly 60 in either the automatic or the manual feed tray and then activate the "form feed" function of the printer. This activation may be done manually or through the use of the computer 90. The user may also desire to print on the laminating material 62 of the laminating assembly 60 while laminating the stock 68. Accordingly, through the use of the computer 90, a normal printing operation may be carried out with the laminating assembly 60 loaded in either of the manual or automatic feeder trays. Alternatively, if a photocopy machine is to be used to laminate the stock 68, a normal copying operation may be carried out with the laminating assembly 60 loaded in the manual or the automatic feeder tray of the photocopier.

With additional reference to FIG. 17, another exemplary embodiment of a laminating assembly 90 of the present invention is illustrated. The laminating assembly 90 includes two sheets of laminating material: a top sheet 92 and a bottom sheet 94. The bottom sheet 94 is defined as the sheet of the laminating assembly 90 which is adjacent to the fuser 102 of the laser printer 24' (or photocopier, etc.) The sheets 92, 94 may be applied with adhesive in accordance with the embodiments described above, and are preferably made from a polyester such as mylar®. The laminating assembly 90 is constructed such that the top sheet 92 and the bottom sheet 94 have different shrink rates (i.e., the rate at which the sheets shrink when subjected to heat). Preferably, the ratio of the shrink rates of the top and bottom sheets 92, 94 is approximately 3:1. In a commercial embodiment of the laminating assembly 90, it is preferable for the shrink rate of the top sheet 92 to be greater than approximately 1.0% and for the shrink rate of the bottom sheet 94 to be less than approximately 1.0%. For example, the top sheet 92 may have an approximately 1.5% shrink rate, while the bottom sheet 94 may have an approximately 0.5% shrink rate.

In addition to the difference in shrink rates, the top sheet 92 is configured such that the polymers of the polyester are oriented in the machine direction, and the bottom sheet 94 is configured such that the polymers of the polyester are oriented in the cross direction. Those skilled in the art understand that *machine direction* indicates that the polymers are longitudinally oriented (that is, in the direction the material was produced on the production line), as shown by arrow M, and that *cross direction* indicates that the polymers are transversely oriented, which is perpendicular to the machine direction, as shown by arrow C. The differences in shrink rate and polymer orientation of the top and bottom sheet 92, 94 eliminate the tendency of the laminating assembly 90 to thermoform.

Furthermore, the top sheet 92 is preferably thicker than the bottom sheet 94. For example, the top sheet 92 may have a thickness of approximately 3 mils, which the bottom sheet 94 may have a thickness of approximately 1 mil. More generally, it is preferable for the bottom sheet 94 to be less than about 2 mils in thickness and for the top sheet 92 to be greater than about 2 mils in thickness. The provision of the relatively thin bottom sheet 94 allows heat from the fuser of the printer 24' to diffuse the thinner bottom sheet 94 and, thus, transfer to the top sheet 92 more efficiently in order to activate the adhesive of the top sheet 92 more effectively. In addition, the provision of the relatively thick top sheet 92 offers more protection for the document to the laminated. Activation of the adhesive of the top sheet 92 is aided to a certain degree by heat from rollers opposite to the fuser 102 in the printer 24'. Because of proximity to the fuser 102, the rollers are heated and provide heat to the laminating assembly 90 while propelling it against the fuser 102. Furthermore, the difference in thickness of the top and bottom sheets 92, 94 allows the laminating assembly 90 to be constructed with a total thickness greater than conventional laminating pouches with sheets of the same thickness.

In accordance with the present invention, the laminating assembly 90 may consist only of either the top sheet 92 or the bottom sheet 94. The laminating material of this one-sheet laminating assembly is configured to have a shrink rate approximately equal to the shrink rate of the material to be laminated to prevent thermoforming. Pressure-sensitive strips may be applied to the sheet 92 or 94 to temporarily adhere the material to be laminated to the laminating assembly as described above.

The laminating assemblies of the present invention may also be used in conduction with a carrier sheet. As printers are designed to print on specifically sized sheets (e.g., 8½ inches by

11 inches, envelopes, A4, legal size, etc.), a standard-sized carrier sheet (that is, 8½ by 11) allows user to use a lamination assembly any size up to 8½ by 11. For example, if a user wants to laminate a business card which is typically 2 inches by 3 inches, the business card may be positioned in a 2-inch-by-3-inch laminating pouch, which may then be positioned with the 8½-by-11 carrier sheet. The combination of the three items may then be fed through a printer. Without a carrier sheet, a user would have to place the business card in a 8½-by-11 laminating pouch and then feed this through a printer, and then trim the excess laminating pouch around the business card.

Those skilled in the art will understand that the preceding exemplary embodiments of the present invention provide foundation for numerous alternatives and modifications. These other modifications are also within the scope of the laminating technology of the present invention. Thus, by way of example but not of limitation, the laminating assembly and method of the present invention may be configured for various types of stock or material to be laminated such as a document or a leaf from a tree, for example, and for various heat-providing devices such as heat presses used for mounting photographs or even household irons. Furthermore, the heat-activated adhesive may be suitable modified to be active in any particular temperature range. Accordingly, the present invention is not limited to that precisely shown and described herein.

CLAIMS

What is claimed is:

1. An assembly for laminating sheet material comprising:

laminating material having two sides and having a first portion and a second portion defined by a fold line;

an inner layer of adhesive having a melting point applied to one of said sides of said laminating material; and

an outer layer of adhesive having a melting point applied to said inner layer of adhesive;

the melting point of said adhesive of said outer layer of adhesive being lower than the melting point of said adhesive of said inner layer of adhesive.

2. The assembly of claim 1 wherein said adhesive of said inner layer of adhesive is active at room temperature.

3. The assembly of claim 1 wherein adhesive of said outer layer of adhesive is inactive at room temperature.

4. The assembly of claim 1 wherein said adhesive of said inner layer of adhesive is a pressure-sensitive adhesive.

5. The assembly of claim 1 wherein the melting point of said adhesive of said outer layer of adhesive is approximately 180°F to 300°F.

6. The assembly of claim 5 wherein the melting point of said adhesive of said inner layer of adhesive is at least approximately 300°F.

7. The assembly of claim 1 wherein said outer layer of adhesive has a surface density which is relatively low when compared to that of said inner layer of adhesive.

8. The assembly of claim 1 wherein said outer layer of adhesive has a surface density of less than about 5 grams per square meter.

9. The assembly of claim 8 wherein said inner layer of adhesive has a surface density of at least about 10 grams per square meter.

10. The assembly of claim **1** further comprising adhesive strips applied to said outer layer of adhesive;

said adhesive strips being active at room temperatures.

11. The assembly of claim **1** wherein said laminating material is heat sealed along said fold line to define a sealed leading edge.

12. The assembly of claim **1** wherein said laminating material is printable thereon.

13. A method for laminating stock in a printing machine having heated components, the method comprising the steps of:

providing a laminating assembly which includes:

laminating material having two sides and having a first portion and a second portion;

an inner layer of adhesive having a melting point and applied to one of said sides of said laminating material; and

an outer layer of adhesive having a melting point and applied to said inner layer of adhesive, the melting point of said outer layer of adhesive being relatively low when compared to the melting point of said inner layer of adhesive;

positioning the stock between said first portion and said second portion of said laminating assembly; and

feeding said laminating assembly with the stock into the printing machine.

14. The method of claim **13** further comprising the step of:

printing on said laminating material of said laminating assembly.

15. The method of claim **13** further comprising the steps of:

providing a laminating sleeve having an inner slot; and

positioning said laminating assembly with the stock in said laminating sleeve;

wherein said feed step comprises the step of:

feeding said laminating with the stock positioned within said laminating sleeve into the printing machine.

16. A method of forming a laminating assembly comprising the steps of:

providing laminating material;

applying an inner layer of adhesive having a melting point to said laminating material;

applying an outer layer of adhesive having a melting point lower than the melting point of said adhesive of said inner layer of adhesive, to said inner layer of adhesive.

17. The method of claim 16 wherein said step of applying an outer layer of adhesive comprises the step of:

applying said outer layer of adhesive at a surface density less than a surface density of said inner layer of adhesive.

18. A laminating system for laminating stock in office machines, comprising:

a laminating assembly including:

laminating material having two sides and having a first portion and a second portion, the stock being positionable within said laminating material;

an inner layer of adhesive having a melting point applied to one of said sides of said laminating material; and

an outer layer of adhesive having a melting point applied to said inner layer of adhesive, the melting point of said adhesive of said outer layer of adhesive being lower than the melting point of said adhesive of said inner layer of adhesive; and

a laminating sleeve having an inner slot defined therein for receiving said laminating assembly.

19. The laminating system of claim 18 wherein said laminating sleeve has a release coating applied in said inner slot.

20. An assembly for laminating sheet material in an office printing machine which has a fuser, said assembly comprising:

a top sheet of laminating material having at least one layer of adhesive applied on one side thereof, said top sheet having a shrink rate; and

a bottom sheet of laminating material having at least one layer of adhesive applied on one side thereof, said bottom sheet being defined as the sheet of said assembly which passes adjacent to the fuser of the office printing machine when said assembly is fed through the office printing machine, said bottom sheet having a shrink rate;

the shrink rate of said bottom sheet being unequal to the shrink rate of said top sheet.

21. The assembly of claim 20 wherein the shrink rate of said top sheet is greater than the shrink rate of said bottom sheet, a ratio of the shrink rates of said top sheet and said bottom sheet is approximately 3:1.

22. The assembly of.claim 20 wherein the shrink rate of said top sheet is greater than approximately 1.0% and the shrink rate of said bottom sheet is less than approximately 1.0%.

23. The assembly of claim 20 wherein said laminating material of said top sheet and of said bottom sheet includes polymers;

said top sheet being configured such that the polymers of said laminating material thereof are oriented in a machine direction; and

said bottom sheet being configured such that the polymers of said laminating material thereof are oriented in a cross direction.

24. The assembly of claim 20 wherein said top sheet and said bottom sheet each have a thickness;

the thickness of said top being greater than the thickness of said bottom sheet.

25. The assembly of claim 24 wherein the thickness of said top sheet is greater than approximately 2 mils and the thickness of said bottom sheet is less than about 2 mils.

AMENDED CLAIMS

[received by the International Bureau on 02 December 1998 (02.12.98); original claims 1, 13, 18 and 20 amended; remaining claims unchanged (5 pages)]

1. An assembly for laminating sheet material comprising:

laminating material having two sides and having a first portion and a second portion defined by a fold line;

an inner layer of pressure sensitive adhesive (PSA) having a melting point and a predetermined thickness adhesively bonded to one of said sides of said laminating material;

an outer layer of adhesive having a melting point and a thickness adhesively bonded to said inner layer of PSA;

the melting point of said adhesive of said outer layer of adhesive being lower than the melting point of said PSA of said inner layer of PSA; and

the thickness of said adhesive of said outer layer of adhesive being less than the predetermined thickness of said PSA of said inner layer of PSA.

2. The assembly of claim 1 wherein said adhesive of said inner layer of adhesive is active at room temperature.

3. The assembly of claim 1 wherein adhesive of said outer layer of adhesive is inactive at room temperature.

4. The assembly of claim 1 wherein said adhesive of said inner layer of adhesive is a pressure-sensitive adhesive.

5. The assembly of claim 1 wherein the melting point of said adhesive of said outer layer of adhesive is approximately 180°F to 300°F.

6. The assembly of claim 5 wherein the melting point of said adhesive of said inner layer of adhesive is at least approximately 300°F.

7. The assembly of claim 1 wherein said outer layer of adhesive has a surface density which is relatively low when compared to that of said inner layer of adhesive.

8. The assembly of claim **1** wherein said outer layer of adhesive has a surface density of less than about 5 grams per square meter.

9. The assembly of claim **8** wherein said inner layer of adhesive has a surface density of at least about 10 grams per square meter.

10. The assembly of claim 1 further comprising adhesive strips applied to said outer layer of adhesive;

said adhesive strips being active at room temperatures.

11. The assembly of claim **1** wherein said laminating material is heat sealed along said fold line to define a sealed leading edge.

12. The assembly of claim 1 wherein said laminating material is printable thereon.

13. A method for laminating stock in a printing machine having heated components, the method comprising the steps of:

providing a laminating assembly which includes:

laminating material having two sides and having a first portion and a second portion;

an inner layer of adhesive having a melting point and a predetermined thickness adhesively bonded to one of said sides of said laminating material; and

an outer layer of adhesive having a melting point and a thickness adhesively bonded to said inner layer of adhesive, the melting point of said outer layer of adhesive being relatively low when compared to the melting point of said inner layer of adhesive;

the thickness of said adhesive of said outer layer of adhesive being less than the predetermined thickness of said adhesive of said inner layer of adhesive;

positioning the stock between said first portion and said second portion of said laminating assembly; and

feeding said laminating assembly with the stock into the printing machine.

14. The method of claim **13** further comprising the step of:

printing on said laminating material of said laminating assembly.

15. The method of claim **13** further comprising the steps of:

providing a laminating sleeve having an inner slot; and

positioning said laminating assembly with the stock in said laminating sleeve;

wherein said feed step comprises the step of:

feeding said laminating with the stock positioned within said laminating sleeve into the printing machine.

16. A method of forming a laminating assembly comprising the steps of:

providing laminating material;

applying an inner layer of adhesive having a melting point to said laminating material;

applying an outer layer of adhesive having a melting point lower than the melting point of said adhesive of said inner layer of adhesive, to said inner layer of adhesive.

17. The method of claim **16** wherein said step of applying an outer layer of adhesive comprises the step of:

applying said outer layer of adhesive at a surface density less than a surface density of said inner layer of adhesive.

18. A laminating system for laminating stock in office machines, comprising:

a laminating assembly including:

laminating material having two sides and having a first portion and a second portion, the stock being positionable within said laminating material;

an inner layer of adhesive having a melting point and a predetermined thickness applied to one of said sides of said laminating material; and

an outer layer of adhesive having a melting point and a thickness applied to said inner layer of adhesive, the melting point of said adhesive of said outer layer of adhesive being lower than the melting point of said adhesive of said inner layer of adhesive, the thickness of said adhesive of said outer layer of adhesive being less than the predetermined thickness of said adhesive of said inner layer of adhesive; and

a laminating sleeve having an inner slot defined therein for receiving said laminating assembly.

19. The laminating system of claim **18** wherein said laminating sleeve has a release coating applied in said inner slot.

20. An assembly for laminating sheet material in an office printing machine which has a fuser, said assembly comprising:

a top sheet of laminating material having at least one layer of adhesive applied on one side thereof, said top sheet having a shrink rate; and

a bottom sheet of laminating material having at least one layer of adhesive applied on one side thereof, said bottom sheet being defined as the sheet of said assembly which passes adjacent to the fuser of the office printing machine when said assembly is fed through the office printing machine, said bottom sheet having a shrink rate;

the shrink rate of said bottom sheet of laminating material being unequal to the shrink rate of said top sheet of laminating material.

21. The assembly of claim **20** wherein the shrink rate of said top sheet is greater than the shrink rate of said bottom sheet, a ratio of the shrink rates of said top sheet and said bottom sheet is approximately 3:1.

22. The assembly of claim **20** wherein the shrink rate of said top sheet is greater than approximately 1.0% and the shrink rate of said bottom sheet is less than approximately 1.0%.

23. The assembly of claim **20** wherein said laminating material of said top sheet and of said bottom sheet includes polymers;

said top sheet being configured such that the polymers of said laminating material thereof are oriented in a machine direction; and

said bottom sheet being configured such that the polymers of said laminating material thereof are oriented in a cross direction.

24. The assembly of claim **20** wherein said top sheet and said bottom sheet each have a thickness;

the thickness of said top being greater than the thickness of said bottom sheet.

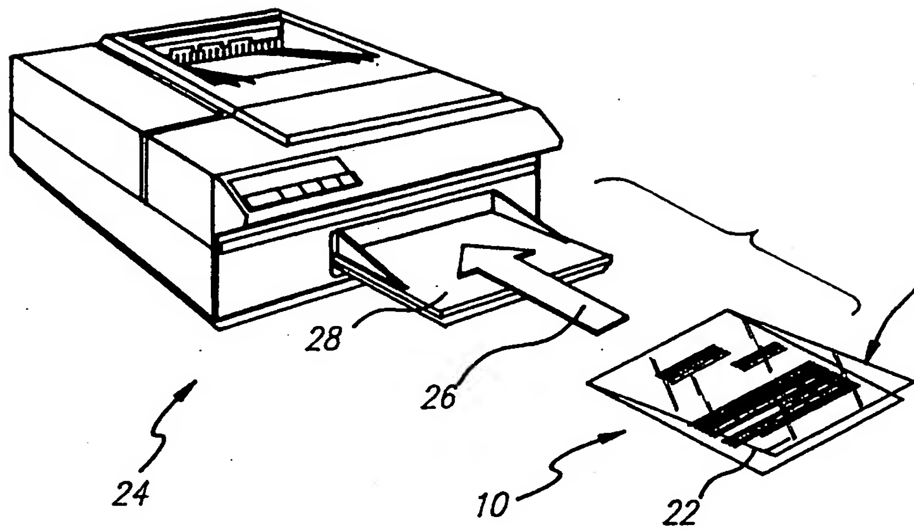

FIG. 3

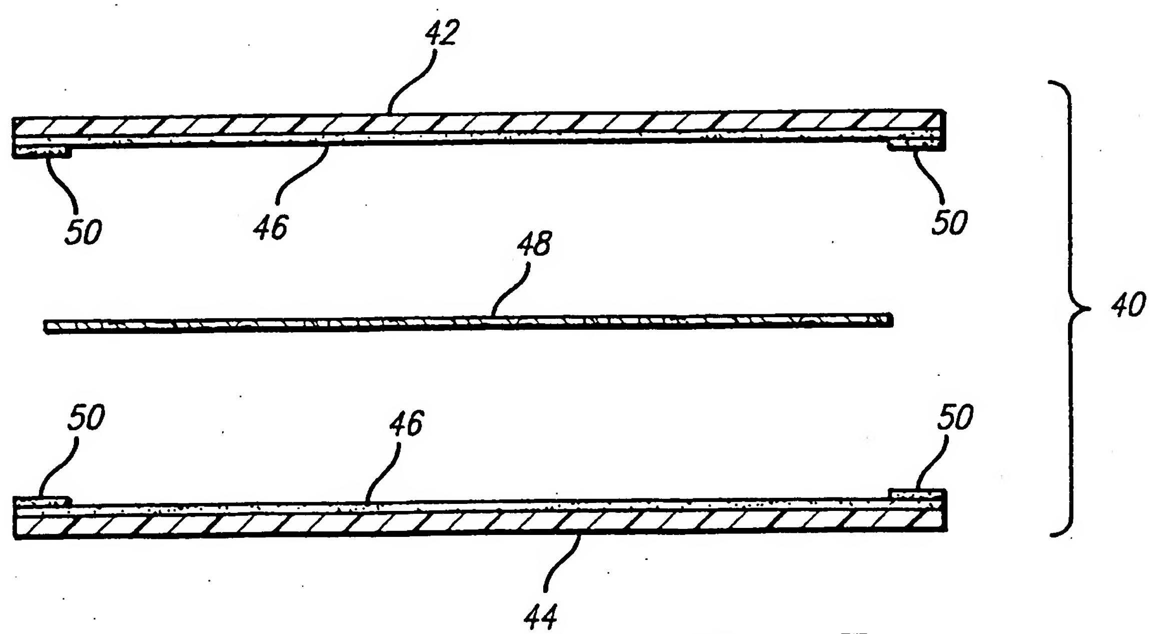

FIG. 5

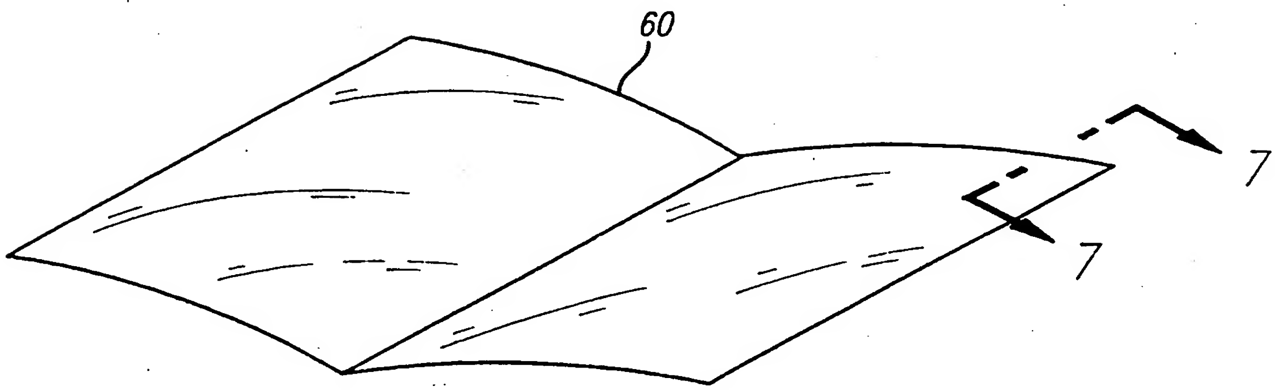

FIG. 6

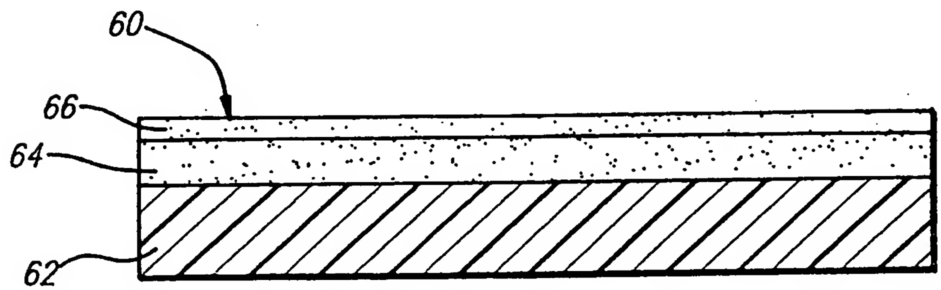

FIG. 7

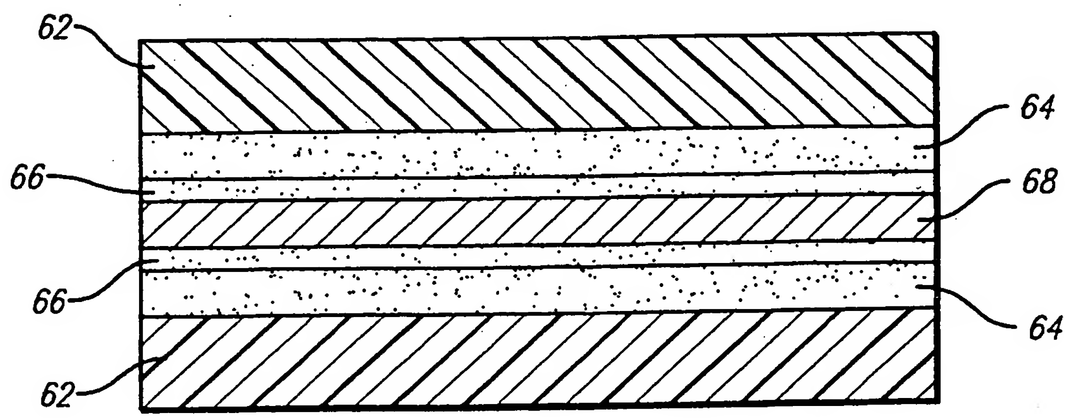

FIG. 8

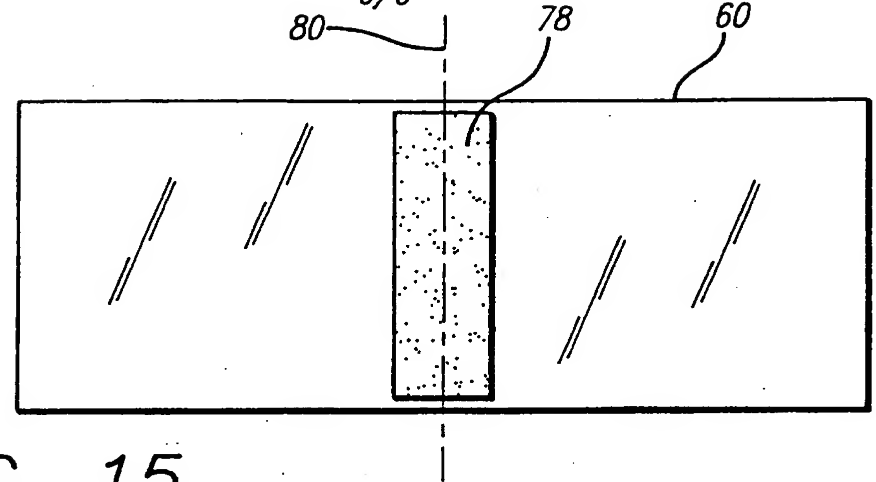

FIG. 15

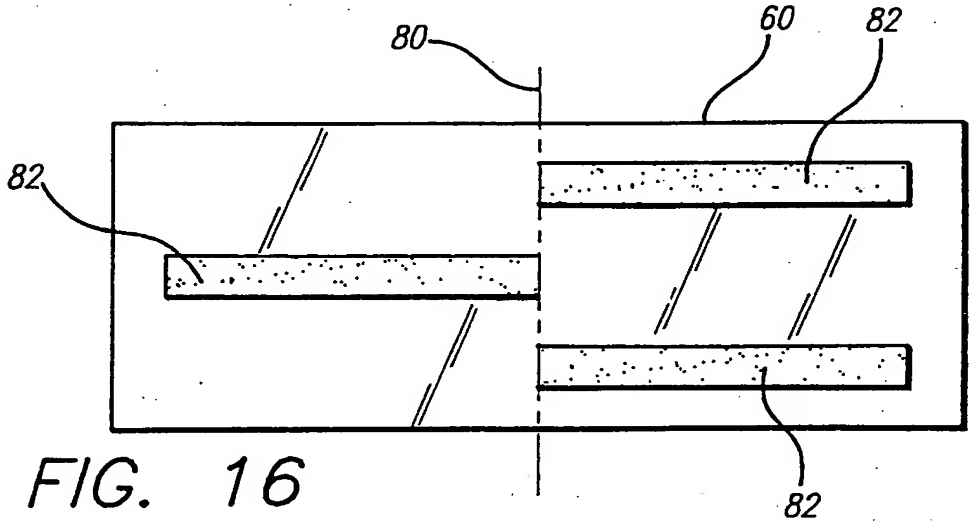

FIG. 16

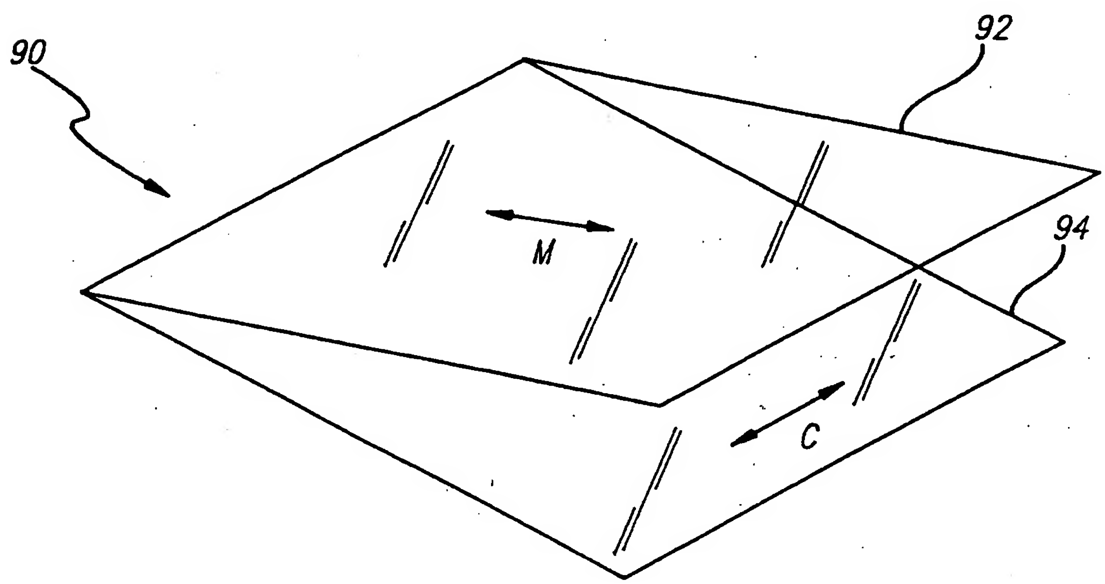

FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/16624

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :C09J 5/02
US CL :156/324.4, 226, 227
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/324.4, 226, 227, 315; 40/359, 630; 283/109; 427/208.2; 428/347

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 4,370,374 A (RAABE et al) 25 January 1983 (25-01-83), see abstract, column 1, lines 5-7, 23-25, 50-52 and 67-68, column 2, lines 1-3, 25-33 and 47-52, column 3, lines 35-41 and 65-68, column 4, lines 33-39 and 56-61.	1-3, 5-9, 12-14, 16-17, 20-25 ---------- 1-15, 18-19
Y	US 2,975,091 A (TOBEY) 14 March 1961 (14-03-61), see Figs. 5-6, column 1, lines 15-24, column 2, lines 31-36, column 5, lines 4-8 and 51-60.	4, 10
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[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/16624

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2,061,678 A (SCOTT) 24 November 1936 (24-11-36), see Fig 2, column 1, lines 5-43, column 2, lines 4-22, column 3, lines 21-34, column 4, lines 5-7 and 43-44, column 5, lines 66-75, column 6, lines 1-3 and 15-24.	13-14